$La_{1-x}A'_xCoO_{3-\delta}$ Perovskite Type Oxides as Catalysts for VOCs Oxidation

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Abstract

$La_{1-x}A'_xCoO_{3-\delta}$ perovskite-type oxides is nonstoichiometry created by substituting the A-site (La) with a bivalent cation (A'=Sr, Ca). For charge balancing, oxygen vacancies form after oxygen desorption resulting structural defects, which are important not only for catalytic activity, but also for oxygen mobility within the perovskites. In the oxidation atmosphere, adsorbed oxygen from the gas phase at different vacant sites leading to charged oxygen adsorption O_2^-, O^-, O^{2-}, play the roles in the catalytic oxidation of volatile organic compounds (VOCs) such as paraffins, and aromatics. Schiff base complex sol-gel method could be used to produce high adsorbed oxygen perovskites type oxides.

Local and electronic structures analyzed by X-ray absorption near edge spectroscopy (XANES) can be used to clarify the high catalytic activity of a perovskte. A bivalent Ca substituted $La_{1-x}Ca_xCoO_{3-\delta}$ ($x = 0 - 0.5$) perovskites were used as examples. All samples were found to have a rhombohedral structure with *R*-3*c* space group by X-ray diffraction (XRD) and the patterns indicated the cell contraction of $La_{1-x}Ca_xCoO_{3-\delta}$ due to the higher amount of the smaller Ca^{2+} substitution in the La^{3+} sites. Co *K*-edge XANES exhibited the oxidation state of Co as that in the unsubstituted $LaCoO_3$ for all samples. Intensities of Co pre-edge features of all samples indicated distorted octahedral symmetry of Co in the perovskite structures. Transition from low spin to high spin configuration of Co, studied by O *K*-edge XANES, appeared in the samples from $x = 0.2$. Ca *K*-edge XANES of each sample showed a systematic change in intensities, indicating the changes of calcium local structure in the bivalent substituted $La_{1-x}Ca_xCoO_{3-\delta}$ perovskite. XANES spectral features indicated spin-state transitions of Co^{3+} and oxygen vacancies induced by substitution of La by the bivalent Ca cation.